Research Note

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THINNING FROM BELOW IN A 60-YEAR-OLD WESTERN WHITE PINE STAND

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Thirty-year results from a test of thinning a 60-year-old western white pine stand indicate that thinning does not appreciably change total volume growth, but it does improve the quality of the final product by increasing diameter growth and improving stand composition.

This test was established in 1919 on the Priest River Experimental Forest, Idaho, to test three degrees of thinning from below in a 60-year-old stand of western white pine. At the time of thinning, the stand contained about 1,000 trees and 175 square feet of basal area per acre. The basal area stocking was 80 percent of normal. Dominant trees were mostly white pine and western larch with an understory of western redcedar and Douglas-fir. The stand is located on a low, level bench having a site index of 64, which is good for white pine.

Four permanent sample plots, each one-half acre in size, were established in the stand and treated as follows:

Plot 105. Left unthinned as a check area.

Plot 106. Thinned lightly from below. This plot was reduced to 65 percent of normal basal area stocking.

Plot 107. A moderate thinning from below left this plot with 50 percent of normal basal area stocking.

Plot 108. Thinned heavily from below. After thinning, this plot contained only 38 percent of normal basal area.

In each of these thinnings the understory was left intact except that trees damaged during the thinning operation were removed.

Measurements at 5-year intervals have shown the development of these plots for 30 years following the initial thinning. Tables 1 and 2 present the cutting, mortality, and growth from 1919 through 1949.

Table 1.--Number of trees and basal areas per acre for all species, Priest River 1919 thinning plots 1/

Item	Plot 105 unthinned		Plot 106 thinned lightly		Plot 107 thinned moderately		Plot 108 thinned heavily	
	Trees	Basal area	Trees	Basal area	Trees	Basal area	Trees	Basal area
Stand:								
1919 before thinning	1,024	183	978	182	966	178	922	165
1919 removed in thinning			424	37	562	69	604	80
1919 after thinning			554	145	404	109	318	85
1929	826	192	504	167	370	131	308	104
1939	652	204	454	192	334	153	290	126
1949	652	220	480	213	394	185	400	153
Mortality 1919-1949	472	50	144	23	90	12	44	9
Gross annual increment 1919-1949		2.9		3.0		2.9		2.6
Net annual increment 1919-1949 (excluding mortality)		1.2		2.2		2.5		2.3
Net annual increment 1919-1949 (excluding mortality and thinnings)		1.2		1.0		.2		- .4
Total production		271		273		265		242

1/ Number of trees and basal area include all trees 0.6 inch d.b.h. and larger. They include ingrowth during the period

Table 2.--Cubic- and board-foot volumes per acre for all species, Priest River 1919 thinning plots 1/

Item	Plot 105 unthinned		Plot 106 thinned lightly		Plot 107 thinned moderately		Plot 108 thinned heavily	
	Cu.ft.	Bd.ft.	Cu.ft.	Bd.ft.	Cu.ft.	Bd.ft.	Cu.ft.	Bd.ft.
Stand:								
1919 before thinning	4,900	11,270	5,039	12,660	5,196	13,212	4,715	14,028
1919 removed in thinning			729	120	1,822	1,992	2,030	4,534
1919 after thinning			4,310	12,540	3,374	11,220	2,685	9,494
1929	6,036	18,632	5,680	20,172	4,559	17,322	3,575	14,208
1939	6,896	24,380	7,030	27,698	5,692	23,220	4,554	19,514
1949	7,976	30,938	8,317	35,172	7,401	31,620	5,928	26,018
Mortality 1919-1949	1,188	2,240	622	1,548	325	990	312	1,110
Gross annual increment 1919-1949	142	730	154	806	145	713	118	588
Net annual increment 1919-1949 (excluding mortality)	102	656	134	754	134	680	108	551
Net annual increment 1919-1949 (excluding mortality and thinnings)	102	656	109	750	74	614	40	400
Total production	9,164	33,178	9,668	36,840	9,548	34,602	8,270	31,662

1/ Cubic-foot volumes include all trees 0.6 inch d.b.h. and larger. Board-foot volumes were computed from total height volume tables based on the Scribner Decimal C log rule. Minimum diameters used in computing board-foot volumes were 7.6 inches for white pine and 9.6 inches for other species.

The plots, though generally comparable at the time of establishment, contained some differences in composition and size of trees. The advantage was in favor of the thinned plots because they contained a higher percentage of white pine than the check plot. The thinned plots also contained more board-foot volume at the time of establishment, but the check plot contained more trees and more basal area. The lightly thinned plot even had more board-foot volume after thinning than the uncut plot because thinning from below removed practically no trees that contained board-foot volume.

EFFECTS OF THINNING

Volume Growth

In the period from 1919 to 1949 the lightly thinned plot outgrew the unthinned plot in both gross and net volume increment (table 2). The gross annual increment on the lightly thinned plot was 154 cubic feet per acre, which is 12 cubic feet more than the growth on the check plot. Excluding mortality, the annual increment on the lightly thinned plot was 32 cubic feet per acre more than on the check plot. The light thinning showed about the same relative advantage in board-foot increment.

Volume growth on the moderately thinned plot was nearly the same as that of the check plot. The heavy thinning apparently was too heavy to maintain good volume growth.

Diameter Growth

The release of selected trees by thinning is reflected in their diameter growth following thinning. Table 3 shows that in this test thinning did increase the diameter growth of dominant and codominant trees. The amount of increase was related directly to the intensity of thinning, the heavy thinning showing the greatest increase in diameter growth.

Table 3.--Diameter growth of dominant and codominant trees following thinning

Plot no.	Weight of thinning	Average d.b.h.		D.b.h. growth
		1919	1949	
		Inches		
105	Unthinned	10.03	12.62	2.59
106	Lightly	10.26	13.22	2.96
107	Moderately	10.24	13.39	3.15
108	Heavily	10.59	13.97	3.38

The average 30-year diameter growth of dominants and codominants on the heavily thinned plot was about 30 percent greater than on the check plot. Diameter growth on the lightly and moderately thinned plots was greater than on the check plot but less than on the heavily thinned plot.

A 30-percent increase in diameter growth is rather small in terms of practical forest management. The difference in diameter growth between the heavily thinned plot and the unthinned plot is .026 inch per year. The resulting differences in average diameter would be 0.26 inch in 10 years and 1.30 inches in 50 years.

The effect of thinning on diameter growth can be illustrated another way. Table 4 shows the distribution of trees 10 inches in diameter and larger by diameter classes. An important increase in diameter following thinning should cause an obvious shift in the distribution of trees. There has been a shift in favor of the thinned plots in this test, but it is too small to be readily apparent 30 years after thinning.

Table 4.--Diameter distribution of trees 10 inches in diameter and larger on thinned and unthinned plots

D.b.h. class	1919				1949			
	Unthinned	Thinned lightly	Thinned moderately	Thinned heavily	Unthinned	Thinned lightly	Thinned moderately	Thinned heavily
	Number of trees				Number of trees			
10	16	16	16	8	14	8	12	10
11	9	13	12	8	17	17	11	5
12	10	6	5	3	17	12	10	11
13	4	9	5	5	2	11	12	9
14	4	3	1	5	8	6	9	6
15	3	2	1		8	8	7	6
16	1	1	1	1	3	6	6	2
17					2	3	2	3
18					3	2	1	3
19					2	2	2	3
20					1	3	1	
21					1			
22								
Totals	47	50	41	30	78	78	73	58

Species Composition

One of the most important benefits of thinning stands of young western white pine is the increased value of the final crop resulting from improved stand composition. White pine generally grows in mixture with several other species, and stands commonly have less than half their volume in white pine. Since white pine has so much greater stumpage value than its associates, a relatively small gain in the proportion of white pine results in a considerable gain in value.

Although no special effort was made in this test to improve species composition, all the treatments did increase the proportion of white pine in the stand (table 5). The heavy thinning made the greatest percentage increase of white pine, but the other thinning treatments resulted in nearly the same proportion of white pine because the thinned plots contained more pine before thinning. The proportion of white pine in the unthinned stand remained nearly constant during the 30-year period.

Table 5.--The effect of thinning on stand composition

Plot no.	Weight of thinning	Proportion of white pine cubic-foot volume in total stand		Increase
		1919 Before thinning	1949	
		Percent		
105	Unthinned	45.4	46.3	0.9
106	Lightly	64.9	70.1	5.2
107	Moderately	59.7	76.6	16.9
108	Heavily	54.0	75.0	21.0

CONCLUSIONS

The results of this test show some general effects of thinning and some differences resulting from varying degrees of cutting. All three treatments stimulated diameter growth of dominant and codominant trees. The heavily thinned plot showed the greatest diameter-growth increase, but that treatment was too heavy to maintain maximum volume growth. The lighter thinnings, on the other hand, stimulated diameter growth and still equalled the volume growth of the unthinned plot.

Thinnings should be light; i.e., they should remove not more than 20 to 25 percent of the cubic-foot volume. The heavy thinning in this test failed to utilize the site completely, resulting in excessive loss in volume growth.

The thinnings in this test enhanced the final value by increasing the proportion of high-value white pine in the stand. This is an important benefit from thinning, but the same results can be gained more effectively and more cheaply by weeding the stand in the reproduction stage.

The cost of these thinnings was a dead-weight expense because the material removed was not merchantable. If the cost of thinning must be carried as an investment cost until the final harvest, most owners probably would not consider the increased volume and diameter increment of the light and moderate thinnings sufficient to make thinning a feasible operation. On the other hand, if the thinned material were salable, the owner would benefit from increased growth in these grades of thinning while marketing potential mortality.